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Should non-genuine products be expelled from markets?

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Should non-genuine products be expelled from markets?*

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Abstract

We develop a model in which a 'genuine' producer supplying genuine products competes with many 'non-genuine' producers supplying the compatible third-party or generic products. We examine whether non-genuine products should be expelled from markets. In particular, we focus on the genuine producer's strategies for driving out non-genuine products: running comparative advertising, building technical barriers, and improving the quality of genuine products. Although the small amount of spending on advertising or building technical barriers improves social welfare, their equilibrium amounts are socially excessive. The quality improvement may raise or reduce welfare, depending on the degree of patent protection. We also find that prohibition of entry of non-genuine producers may improve welfare by discouraging the genuine producer from implementing the drive-out strategies.

Keywords: Genuine products, advertising, technical barriers, anti-trust law.
JEL Code:L13, L15.

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1 Introduction

Should non-genuine products, which are sometimes called generic and third-party products, be expelled from markets by legal restriction only because they are not genuine? When we focus on the protection of first mover's advantage, this question seems to be redundant. Taking into consideration the fact that non-genuine producers do not pay the cost for inventing a new product and introducing it into the market, it may be natural to consider that non-genuine products should be expelled from the market.

However, to answer this question rigorously, we should shed light on the difference between genuine and non-genuine products from the viewpoints of consumers and the behavior of producers of genuine/brand-name products (genuine producers). In this context, the following questions arises: Why do consumers consider the quality of genuine products to be higher than that of non-genuine products? There are two reasons that underlie this belief. First, the quality of genuine products is truly higher than that of non-genuine products. For example, consumers know that the lives of branded bags are typically much longer than that of non-branded bags and that non-genuine items are sometimes significantly inferior to genuine items. Second, consumers, who are exposed to a significant amount of persuasive and comparative advertising, are misled by genuine producers. For perishable items, such as machine parts and ink cartridges, genuine products may fit machines better than non-genuine products. Thus, consumers may be easily misled by genuine producers who exaggerate the advantage of using their products.

Genuine producers typically have market power; the most important source of market power is consumers' love of genuineness. Some consumers prefer genuine products to non-genuine products even if the former are significantly more expensive than the latter and the difference in quality between the two types of products is small, although others do not care about the quality difference and buy non-genuine products.[1] Genuine producers are able to set higher prices because of the existence of consumers who are enthusiastic about genuineness.

This market power provides genuine producers with opportunities to increase their profits. First, as noted above, genuine producers mislead consumers by running comparative advertising against non-genuine products, which increases demand for their products.[2]

[1]Regarding brand-name products, a survey found that two-thirds of consumers are happy to sport fake products ("ANALYSIS: Keeping it real," *IN-STORE*, Aug 2007, 9-11).

[2]In this paper, comparative and persuasive are synonymous.

Second, they establish technical barriers against non-genuine products: It becomes costly for non-genuine producers to produce compatible products. For example, a printer maker may make ink cartridges produced by third parties incompatible with its printers. A common theme in these two strategies is that genuine producers try to drive out non-genuine products from the market. Third, quality improvement makes it possible for producers to set higher prices and, accordingly, make higher profits. Thus, genuine producers are likely to invest in improving the quality of their products.

The purpose of this paper is to examine a genuine producer's behavior of driving out non-genuine products. In particular, our research questions are as follows: (i) how the strategic behavior of a genuine producer, such as running comparative advertising, establishing technical barriers, and improving the quality of the product, affects the market equilibrium; (ii) whether or not the government should regulate such behavior of the genuine producer; and (iii) whether or not the government should regulate the entry of firms that supply non-genuine products (non-genuine producers).

Governments generally have several options for regulating genuine or non-genuine producers. For example, intellectual property law can be used to drive out non-genuine producers by granting a genuine producer an exclusive right to the market for a certain period. Patent law is effective, in particular, in the case of industrial goods, whereas a design right is effective in driving out imitators in the case of dresses and bags. Governments can also establish entry barriers by creating regulations, such as technical standards. On the other hand, antitrust law can be used to promote the entry of non-genuine producers by reducing the monopoly power of a genuine producer. Removal of technical standards is also effective in introducing competition into markets.

We adopt a model in which both genuine and non-genuine products are supplied. The former is supplied by one firm, whereas the latter is supplied competitively. The genuine producer has two strategies for increasing demand for its products in the basic model: advertising and technical barriers. The former strategy increases the perceived utility of consumers and the latter strategy increases the marginal cost of non-genuine producers. Accordingly, both strategies generate a demand shift from non-genuine to genuine products. We also consider the case in which the genuine producer can invest in quality improvement.

Persuasive advertising has been analyzed in the field of industrial organization for sev-

eral decades.[3] Recently, Glaeser and Ujhelyi (2010) examined the welfare effect of misinformation when firms engage in Cournot competition. Hattori and Higashida (2012, 2014, 2015) also examined the effect of misleading advertising on welfare when firms' products are differentiated.[4] Unlike Glaeser and Ujhelyi (2010) and Hattori and Higashida (2012, 2015), we consider technical barriers and quality investment in addition to advertising.

In terms of the imitating activities of follower firms, innovation has been examined in the literature. For example, see Klempler (1990), Gallini (1992), Pepall and Richards (1994), Lyon and Huang (1996), Wright (1999), Ceccagnoli (2005), and Bessen and Maskin (2009), among others. Unlike the literature on innovation and imitation, we focus on the welfare effect of legal restrictions relating to genuine producers' advertising and technical barriers.[5]

The main results of our study are as follows. Both advertising and technical barriers are excessive in market equilibrium in terms of social welfare, although a small amount/level of advertising/technical barriers improves welfare. The reason why a small advertising/technical barriers is welfare improving is that genuine products are supplied insufficiently without advertising and technical barriers. Advertising and technical barriers mitigate this insufficiency by shifting consumption from non-genuine products to genuine products. However, advertising and technical barriers are costly, and the cost of non-genuine products also increases in the case of technical barriers. In addition, the demand increase for genuine products leads to a price increase in the genuine product. Because the genuine producer does not take into consideration the loss of consumers and the cost increase in the production of non-genuine products, advertising and technical barriers are excessive in market equilibrium.

We find that both advertising and technical barriers complement each other in terms of the profit of the genuine producer. Therefore, the greater number of strategies a genuine producer has, the more excessively non-genuine products are driven out. Because this excessiveness is serious, welfare is necessarily greater under complete prohibition of both advertising and technical barriers than at the market equilibrium. We also find that prohibition of entry of non-genuine producers may improve welfare. Entry of non-genuine

[3]See Bagwell (2007) for a survey on the economics of advertising.

[4]Persuasive advertising has also been analyzed in the field of consumer research. For example, Rajagopal and Montgomery (2011) examined the effect of false memories on consumers' behavior and showed that exposure to imagery-evoking advertising can result in erroneous beliefs.

[5]Mizuno and Odagiri (1990) considered a situation in which firms spend on both advertising and R&D. However, they did not consider regulations and welfare.

producers promotes competition, but it induces increases in advertising and technical barriers. Prohibition expunges the benefits gained from competition but saves on the costs of advertising and technical barriers. When the genuine producer chooses to implement a large amount of advertising and a high level of technical barriers, the saved costs are large under prohibition of non-genuine products.

Moreover, the analysis of investment in quality improvement by a genuine producer gives rise to interesting results. The amount of investment is insufficient given certain amounts of advertising and technical barriers in terms of social welfare. However, a quality improvement of genuine products leads to increases in advertising and technical barriers. Then, the distortion caused by these two strategies used by the genuine producer increases, which may spoil the positive welfare effect of quality improvement.

The structure of the paper is as follows. Section 2 provides real-world examples, Section 3 constructs the basic model, Section 4 examines legal restrictions on advertising and technical barriers used by a genuine producer, Section 5 examines the prohibition of entry of non-genuine producers, Section 6 introduces quality investment by a genuine producer, and Section 7 provides concluding remarks.

2 Examples

We can observe notable examples of the effects of comparative advertising and technical barriers in the market for printer ink. Battles for office machine after-products have been ongoing over the past few decades. In 1995, Hewlett-Packard, Canon, and Seiko Epson sued Nu-Kote, which supplied non-genuine ink cartridges, for infringing on patents held by the first three giant suppliers, which supply genuine cartridges.[6]

Consumers typically consider the quality of genuine cartridges to be higher than that of non-genuine ones. In a certain sense, this belief is true. Jeff (2008) tested both brand-name and third-party inks to compare image quality and fade resistance and proved that genuine inks produce better-quality prints and are more resistant to fading. However, Jeff (2008) also concluded the following:[7]

Deciding between brand-name and third-party alternatives depends in part on how you plan to use your prints. — If your prints tend to be for one-time-only office presentations,

[6]See *The New York Times* article titled "Patents" on October 30, 1995.

[7]The article in *The New York Times* titled "New printer cartridge or a refill? either way, ink is getting cheaper" drew similar conclusions about this choice problem for consumers (Feb 4, 2006).

text documents for school, or temporary color images (such as plain-paper photos), inks from third-party supplies may be a reasonable cost-saving option.

Observing real situations, we notice that many consumers prefer genuine products to non-genuine products. For some people, the higher quality of genuine inks is important because they need to keep photos for a long period of time. However, other people appear to be misled by the suppliers of genuine ink cartridges. These suppliers sometimes emphasize the facts that genuine ink is more accurate and has a longer lifespan and that non-genuine ink causes battered prints, toner leakage, and even printer malfunctions. This type of comparative advertising gives rise to consumers' bias towards genuine inks.

The suppliers of genuine inks often establish technical barriers to entry of non-genuine ink. For example, these suppliers sometimes warn that they do not give warranties for printers if consumers use third-party inks. Canon began to sell printers that reject third-party inks by setting a filter against infrared light in its printers because third-party ink cartridges radiate infrared light, whereas Canon's genuine ink cartridges radiate visible rays.[8]

Moreover, patent law sometimes plays a key role in the market for ink cartridges. Printer makers have numerous patents on ink/toner cartridges, which lead to higher quality prints. However, these companies may use patent systems to drive out non-genuine products. There have been several lawsuits over the past two decades regarding this issue. For example, Epson filed a patent infringement lawsuit against a third-party ink cartridge producer in China in 2001. Epson also sued other third parties and won the lawsuits in 2005.[9] Canon and Epson also claimed that recycled ink cartridges infringed upon the patents held by these printer makers and requested an injunction in Japan. However, Canon and Epson lost these lawsuits in 2004 and 2006, respectively. The presiding judge determined that the patents under consideration lacked novelty.[10] In 2011, Canon won another lawsuit against six third parties regarding the infringement of Canon's patent on LED cartridges. Although lawsuits have drawn much attention to date, it is clear that regulation policies influence the competition among genuine and non-genuine producers.

[8]Third parties filed a lawsuit on the violation of the competition law.

[9]See the following articles: "Epson files patent infringement lawsuit against prominent replacement cartridge manufacturer (*Business Wire*, 17 Apr, 2001)," "Seiko Epson wins ink cartridge patent suit in U.S. (*Jiji Press English News Service*, 11 Mar, 2005).

[10]See the following articles: "Court ruling on cartridge deals blow to Canon (*FT.com*, 8 Dec, 2004)" and "Seiko Epson loses suit on ink cartridge patent (*Jiji Press English News Service*, 18 Oct, 2006)."

Our analysis can be applied to other types of markets, including brand-name bags, brand-name clothes and auto parts, to name a few. For example, consider the case of street vendors who sell imitation goods close to the department stores and genuine shops. In some cases, they are driven out from the street by law because selling those goods is regarded as piracy. However, in other cases, vendors keep selling a great variety of imitation goods.[11] Authorities can establish the rules of vending, such as regulations on the vending place. Moreover, genuine shops can hire security guards to prevent street vendors from selling imitation goods in front of their shops. In both cases, the cost of selling imitation goods for street vendors increases. The former case is considered a government intervention, and the latter case is considered one of technical barriers established by genuine shops.

3 The Model

There exists a continuum of heterogeneous consumers who differ in their degree of love of genuineness in products, θ, which is assumed to be uniformly distributed among consumers, $\theta \in [0, \bar{\theta}]$, with unit density. Two types of products are supplied to the market: a genuine product (good 1) and a non-genuine product (good 2). The two products are compatible in the sense that both are equipped with basic properties. Each consumer purchases either product.[12] The 'perceived' (or 'ex-ante') surplus of consumers θ is defined as follows:

$$u_s = \begin{cases} u_{s,1} = v_1 + s - p_1 + \theta, \\ u_{s,2} = v_2 - p_2, \end{cases}$$

where v_i, p_i, and s denote the true quality, the price of the good i ($i = 1, 2$), and the degree of misperception, respectively. The variable θ is also considered to represent additional qualities, which, depending on the consumer, produce different amounts of surplus. Misperception, s, is created by a genuine producer through comparative advertising. A positive amount of s implies that consumers misperceive the quality of genuine product to be higher than it truly is. We assume that consumers are naïve, i.e., they only observe $v_1 + s$ regarding the quality of good 1. Thus, they determine which type of product to buy based on the perceived surplus.

[11] See Rozhon and Thorner (2005).

[12] As noted below, the market is fully covered in the present setting of the model. See Assumption 1.

On the other hand, 'true' (or 'ex-post') consumer surplus is defined as follows:

$$u_t = \begin{cases} u_{t,1} = v_1 - p_1 + \theta, \\ u_{t,2} = v_2 - p_2. \end{cases}$$

Because misperception affects consumers' preferences before a purchase but does not affect the utility of consuming it, it is not included in the true surplus.

A marginal consumer, who is indifferent between purchasing goods 1 and 2, is represented as:

$$\hat{\theta} = (p_1 - p_2) - (v_1 + s) + v_2. \tag{1}$$

Therefore, the demand for each type of product is as follows:

$$x_1 = \bar{\theta} - \hat{\theta}, \quad x_2 = \hat{\theta}. \tag{2}$$

The genuine product is supplied by only one firm, firm 1 (a genuine producer), whereas non-genuine products are supplied competitively. Firm 1 can run comparative advertising to create misperception: Advertising makes the artificial contrast between genuine and non-genuine products sharper from the consumers' point of view.

Firm 1 can also set technical barriers against the entry of non-genuine producers. The technical barriers increase the marginal cost of supplying non-genuine products, $\tilde{c}_2$; in particular, the marginal cost is given by $\tilde{c}_2 = c_2 + b$, where c_2 and b denote the ordinary marginal cost and the level of technical barriers, respectively. The competitive supply of non-genuine products ensures that $p_2 = \tilde{c}_2$. We assume that $v_2 - \tilde{c}_2 > 0$, implying that it is impossible for firm 1 to completely drive out non-genuine products from the market by implementing only technical barriers.

Let $C_s(s)$ and $C_b(b)$ respectively denote the cost of running advertising and the cost of setting technical barriers with $C_j' > 0$ and $C_j'' > 0$ $(j = s, b)$. For simplicity, we specify the cost functions as: $C_s(s) = \mu_s s^2/2$ and $C_b(b) = \mu_b b^2/2$, where $\mu_j > 0$ $(j = s, b)$ is the cost parameter. We assume both costs are independent of each other.

The profit of firm 1 is given by

$$\pi_1 = (p_1 - c_1) \cdot x_1 - C_s(s) - C_b(b) = (p_1 - c_1) \cdot x_1 - \frac{1}{2}\mu_s s^2 - \frac{1}{2}\mu_b b^2,$$

where c_1 denotes the marginal cost of producing a genuine product. Firm 1 chooses the price, the amount of advertising, and the level of technical barriers such that its profit is maximized.

The government knows the true quality of good 1. Thus, the consumer surplus is evaluated based not on perceived surplus, u_s, but on true surplus, u_t.[13] Welfare is defined as:

$$W = (v_2 - \tilde{c}_2)\hat{\theta} + \int_{\hat{\theta}}^{\bar{\theta}} (v_1 - p_1 + \theta) d\theta + \pi_1. \tag{3}$$

The first term on the right-hand side represents the sum of the true surplus of consumers who purchase the non-genuine product, whereas the second term represents the sum of the true surplus of consumers who purchase the genuine product.

3.1 Equilibrium Misperception and Technical Barriers

As a benchmark, we characterize the market equilibrium where the genuine producer sets p_1, s, and b in the absence of any regulations by the government. The first-order conditions (FOCs) for firm 1 are given by

$$\frac{\partial \pi_1}{\partial p_1} = x_1 - (p_1 - c_1) = 0, \tag{4}$$

$$\frac{\partial \pi_1}{\partial s} = (p_1 - c_1) - \mu_s s = 0, \tag{5}$$

$$\frac{\partial \pi_1}{\partial b} = (p_1 - c_1) - \mu_b b = 0. \tag{6}$$

Note that $\partial^2 \pi_1 / \partial k^2 < 0$ $(k = p_1, s, b)$. Moreover, the second-order conditions (SOCs) are assumed to be satisfied.[14]

In the following, we use $g_i \equiv v_i - c_i$, $(i = 1, 2)$ and $G \equiv g_1 - g_2$ to respectively represent the true-quality-cost gap of each type of product and the difference in the gaps. Then, using (4), (5), and (6), the market equilibrium is characterized as:

$$p_1^* = \frac{\mu_s \mu_b (\bar{\theta} + G)}{2\mu_s \mu_b - \mu_s - \mu_b} + c_1, \tag{7}$$

$$x_2^* = \hat{\theta}^* = \frac{(\mu_s \mu_b - \mu_s - \mu_b)\bar{\theta} - \mu_s \mu_b G}{2\mu_s \mu_b - \mu_s - \mu_b}, \quad x_1^* = \bar{\theta} - \hat{\theta}^* = \frac{\mu_s \mu_b (\bar{\theta} + G)}{2\mu_s \mu_b - \mu_s - \mu_b}, \tag{8}$$

$$s^* = \frac{\mu_b (\bar{\theta} + G)}{2\mu_s \mu_b - \mu_s - \mu_b}, \quad b^* = \frac{\mu_s (\bar{\theta} + G)}{2\mu_s \mu_b - \mu_s - \mu_b}, \tag{9}$$

Note that $2\mu_s \mu_b - \mu_s - \mu_b > 0$ from the assumption that the SOCs hold. The equilibrium values depend on the true-quality-cost gap of the two types of products, G, and the cost parameters, μ_s and μ_b. Moreover, we formulate the following assumption.

[13] We follow pre-advertising welfare that is defined by Dixit and Norman (1978).

[14] The second inequality in Assumption 1 ensures that the SOCs hold.

Assumption 1 *The following four inequalities hold:*

$$\bar{\theta} + G > 0, \qquad \mu_s\mu_b - \mu_s - \mu_b > 0, \qquad \bar{\theta} > \frac{\mu_s\mu_b G}{\mu_s\mu_b - \mu_s - \mu_b}, \qquad g_2 > \frac{\mu_s(\bar{\theta} + g_1)}{\mu_b(2\mu_s - 1)}.$$

The first inequality ensures a positive quantity of genuine products, whereas the second and third conditions ensure a positive quantity of non-genuine products. The fourth inequality ensures that $v_2 - p_2 = v_2 - \tilde{c}_2 > 0$, implying that the consumers obtain positive utilities from buying non-genuine products.

4 Should Genuine Producers Be Regulated?

4.1 Excessive or Insufficient?

To verify whether the behavior of the genuine producer should be regulated, we first investigate whether the equilibrium level of advertising and technical barriers are excessive or insufficient in terms of welfare. To this end, we divide the analysis of firm 1's choice into two stages: In the first stage, firm 1 chooses the level of advertising and technical barriers, and in the second stage, it determines the price of the genuine product.[15]

Let superscript E denote the equilibrium variable in the second stage. Therefore, firm 1's profit in the first stage (Π_1), before choosing s and b, is given by

$$\Pi_1 = \left(p_1^E(s,b) - c_1\right) \cdot x_1^E(s,b) - \frac{1}{2}\mu_s s^2 - \frac{1}{2}\mu_b b^2.$$

Note that p_1^E and x_1^E satisfy (1), (2), and (4).

From (4), (5), and (6), it is obtained that

$$\frac{\partial \Pi_1}{\partial j} = \frac{\bar{\theta} + (v_1 + s - c_1) - (v_2 - c_2 - b)}{2} - \mu_j j = 0, \qquad j = s, b. \tag{10}$$

Based on Assumption 1 and the fact that $\partial^2\Pi_1/\partial s\partial b = 1/2$, the SOCs are satisfied for this profit maximization problem in the first stage.[16]

Let us focus on the first stage. From (4),

$$\hat{\theta}^E = \frac{\bar{\theta} - (v_1 + s - c_1) + (v_2 - c_2 - b)}{2}.$$

Therefore, partial differentiation of welfare with respect to advertising yields

$$\frac{\partial W}{\partial s} = -\frac{v_2 - \tilde{c}_2}{2} - \int_{\hat{\theta}^E}^{\bar{\theta}} \frac{1}{2} d\theta + \frac{v_1 - p_1 + \hat{\theta}^E}{2} + \frac{\partial \Pi_1}{\partial s}. \tag{11}$$

[15] Because all of the endogenous variables are determined by firm 1, the sequential and simultaneous choice of variables leads to the same result at the market equilibrium.

[16] If the second inequality of Assumption 1 holds, $\mu_s > 1$ and $\mu_b > 1$ hold.

The first term in the right-hand side represents the loss from a decrease in the consumption of good 2; the second term represents the loss from the price increase of good 1; and the third term represents the benefit from an increase in the consumption of good 1. Because $v_2 - \tilde{c}_2 = v_1 + s - p_1 + \hat{\theta}^E$ holds in equilibrium, the evaluation of (11) at $\partial\Pi_1/\partial s = 0$ yields

$$\left.\frac{\partial W}{\partial s}\right|_{\partial\Pi_1/\partial s=0} = -\frac{s}{2} - \int_{\hat{\theta}^E}^{\bar{\theta}} \frac{1}{2} d\theta = -\frac{s}{2} - \frac{x_1}{2} < 0, \tag{12}$$

which implies that the equilibrium advertising is socially excessive.

We also obtain

$$\frac{\partial W}{\partial b} = -\hat{\theta}^E - \frac{v_2 - \tilde{c}_2}{2} - \int_{\hat{\theta}^E}^{\bar{\theta}} \frac{1}{2} d\theta + \frac{v_1 - p_1 + \hat{\theta}^E}{2} + \frac{\partial \Pi_1}{\partial b}. \tag{13}$$

In addition to the effect of advertising, the loss from an increase in the marginal cost of supplying good 2 arises (the first term on the right-hand side). Similar to the case of advertising, the evaluation of (13) at $\partial\Pi_1/\partial b = 0$ yields

$$\left.\frac{\partial W}{\partial b}\right|_{\partial\Pi_1/\partial b=0} = -\hat{\theta}^E - \frac{s}{2} - \int_{\hat{\theta}^E}^{\bar{\theta}} \frac{1}{2} d\theta = -\hat{\theta}^E - \frac{s}{2} - \frac{x_1^E}{2} < 0, \tag{14}$$

which implies that the equilibrium technical barriers is also socially excessive. Note that

$$\frac{\partial^2 W}{\partial s^2} = -\frac{3}{4} + \frac{\partial^2 \Pi_1}{\partial s^2} < 0, \quad \frac{\partial^2 W}{\partial b^2} = \frac{1}{4} + \frac{\partial^2 \Pi_1}{\partial b^2} < 0, \quad \frac{\partial^2 W}{\partial s \partial b} = -\frac{1}{4} + \frac{\partial^2 \Pi_1}{\partial s \partial b} > 0.$$

These inequalities imply that the SOCs for welfare maximization are satisfied.

Equations (11) and (13) do not imply that advertising and technical barriers always harmful to welfare. The evaluation of (11) at $s = b = 0$ yields

$$\left.\frac{\partial W}{\partial s}\right|_{s=b=0} = \frac{x_1}{2} + \left.\frac{\partial \Pi_1}{\partial s}\right|_{s=b=0} > 0.$$

Similarly, the evaluation of (13) at $s = b = 0$ yields

$$\left.\frac{\partial W}{\partial b}\right|_{s=b=0} = -\hat{\theta} + \frac{x_1}{2} = -x_2 + \frac{x_1}{2} + \left.\frac{\partial \Pi_1}{\partial b}\right|_{s=b=0},$$

which implies that a small amount of technical barriers improves welfare if $x_1 \geq 2x_2$. Thus, we have the following proposition.

Proposition 1

(i) Both equilibrium level of advertising of a genuine product and technical barriers to the entry of non-genuine products are excessive from a welfare point of view.

(ii) A small amount of advertising necessarily improves welfare.

(iii) A small technical barrier to the entry of non-genuine products improves welfare if the market share of genuine products is large ($x_1 \geq 2x_2$).

Proposition 1 implies that the optimal (in the sense of second-best) levels of advertising and technical barriers are between zero and those at market equilibrium. The intuition is as follows. Advertising does not change any of the true qualities or marginal costs $(v_i,\ c_1,\ \tilde{c}_2)$. Because firm 1 has market power, the price-cost margin $(p_1 - c_1)$ is positive. Thus, if $s = 0$, $\hat{u}_{t,1} = \hat{u}_{s,1} = \hat{u}_{s,2} = \hat{u}_{t,2}$ and $\hat{u}_{t,1} + p_1 - c_1 > \hat{u}_{t,2}$ hold, where $\hat{u}_{s,i}$ and $\hat{u}_{t,i}$ represents the perceived and true surpluses of a marginal consumer when purchasing good i $(i = 1, 2)$. For the following analysis, we refer to $u_{t,1} + p_1 - c_1$ as the gross surplus of good 1, which is different from perceived or true consumer surpluses ($u_{s,1}$ or $u_{t,1}$). A small increase in advertising induces a purchase shift from non-genuine to genuine products. Thus, when evaluated at $s = 0$, a small increase in advertising increases the gross surplus of good 1 and, accordingly, welfare. This situation is illustrated in Figure 1, in which c_i $(i = 1, 2)$ and b are assumed to be zero. Superscript O denotes the case without advertising, and p_1' and $\hat{\theta}'$ represent the price and the consumer, who is indifferent between the two types of products when a small amount of advertising is sent by firm 1, respectively. The lightly shaded area represents welfare when there is no advertising. A small amount of advertising decreases the consumer surplus because the price of the genuine product increases and its true quality does not change. However, a certain number of consumers shift their purchasing products from non-genuine to genuine products, which increases the gross surplus of good 1, which is defined as $u_{t,1} + p_1 - c_1$.[17] The net increase in gross surplus is indicated by the dark shaded area.

A small increase in technical barriers has the same effect on the purchasing behavior of a marginal consumer because it shifts purchases from non-genuine products to genuine products. In this sense, welfare increases. However, technical barriers increase the marginal cost of supplying non-genuine products. Thus, $\hat{u}_{s,2} (= \hat{u}_{t,2})$ decreases. In this respect, welfare decreases. When the market share of genuine products is large, the former effect dominates the latter, leading to welfare improvement. The situation is illustrated in Figure 2, in which c_i $(i = 1, 2)$ and s are assumed to be zero. The dark shaded area represents an increase in welfare due to a small amount of technical barriers, arising from the shift of purchasing products from non-genuine to genuine products. The lightly shaded area represents a decrease in consumer surplus due to an increase in the marginal cost of supplying non-genuine products.

When the effect of an increase in advertising is evaluated at $s > 0$, welfare does not

[17] Note that the cost of running advertising is not shown in this figure.

necessarily increase. In this case, $\hat{u}_{t,1} < \hat{u}_{s,1} = \hat{u}_{s,2} = \hat{u}_{t,2}$ holds. Thus, a purchase shift by a marginal consumer from a non-genuine product to a genuine product decreases his/her own true surplus. In addition, similar to the case of no advertising, a true surplus of consumers of good 1 necessarily decreases because of the higher price set by firm 1, although the profit of firm 1 may increase even if the cost for running advertising increases. Thus, an increase in the profit of firm 1 may not dominate a decrease in the consumer surplus. In such a case, advertising at market equilibrium is excessive in terms of welfare. The excess amount of technical barriers can be analyzed in a similar manner.

The loss to consumers should be noted again. An increase in advertising increases the price of a genuine product. Thus, a consumer who continues to purchase a genuine product clearly loses. A consumer who changes her/his purchased product from a non-genuine to genuine product also loses because he/she changes his/her consumption behavior because of advertising; advertising does not improve true quality. A consumer who continues to purchase a non-genuine product neither gains nor loses from an increase in advertising. However, in the case of higher technical barriers, a consumer who continues to purchase a non-genuine product also loses due to the higher price of non-genuine products. Thus, even if welfare improves due to an increase in advertising or technical barriers, consumers lose from the change. In this sense, advertising and technical barriers have a type of redistribution effect from consumers to the genuine producer.

4.2 Regulating the Genuine Producer

It may sometimes be difficult for the government to fine-tune the level of advertising and technical barriers by regulations. In such a case, complete prohibition of the genuine producer's strategies to drive out non-genuine products may be an alternative. This policy restricts the rights of firm 1 to increase its market share by lowering compatibility or running comparative advertising, whereas it allows non-genuine producers to enter the market more freely.

First, we compare the market equilibrium with the situation in which both advertising and technical barriers are prohibited: we refer to the latter situation as complete prohibition and let superscript CP denote this situation. In the absence of both advertising and technical barriers, the consumer who is indifferent between both types of products is represented as

$$\hat{\theta}^{CP} = p_1 - c_2 - v_1 + v_2.$$

In this case, firm 1 can choose only the price of its product. Thus, the FOC is $\partial\pi_1/\partial p_1 = 0$. In turn, we obtain the equilibrium price and consumption quantities:

$$p_1^{CP} = \frac{\bar{\theta} + G}{2} + c_1, \quad x_1^{CP} = \frac{\bar{\theta} + G}{2}, \quad x_2^{CP} = \bar{\theta} - x_1^{CP} = \frac{\bar{\theta} - G}{2}. \tag{15}$$

From Assumption 1 and equations (7) and (8), it is clear that the price and the quantity of the genuine product consumed are greater at the market equilibrium than under complete prohibition. Accordingly, the profit of firm 1 is greater in the former situation than in the latter.

On the other hand, complete prohibition necessarily increases consumer surplus. First, because technical barriers vanish, consumers who keep purchasing non-genuine products benefit from a price decrease of the non-genuine product. Second, the prohibition of advertising lowers the price of the genuine product, which benefits consumers who keep purchasing genuine products. Third, because the consumer surplus gained by purchasing either type of product increases, consumers who change the type of product they purchase also benefit from complete prohibition.

In terms of welfare, the effect of complete prohibition can be divided into four parts. First, the benefit from the disappearance of technical barriers is given by

$$x_2^* \cdot b^* = \frac{(\mu_s\mu_b - \mu_s - \mu_b)\bar{\theta} - \mu_s\mu_b G}{2\mu_s\mu_b - \mu_s - \mu_b} \cdot \frac{\mu_b(\bar{\theta} + G)}{2\mu_s\mu_b - \mu_s - \mu_b}, \tag{16}$$

which is necessarily positive. Second, the costs of running advertising and setting technical barriers are saved; the amount is

$$\frac{\mu_s(s^*)^2}{2} + \frac{\mu_b(b^*)^2}{2} = \frac{\mu_s\mu_b(\mu_s + \mu_b)(\bar{\theta} + G)^2}{2(2\mu_s\mu_b - \mu_s - \mu_b)^2} \tag{17}$$

which is clearly positive. Third, from (3), the effect of purchase shift is given by

$$\begin{aligned} &-(x_1^* - x_1^{NB*}) \cdot G - \frac{\hat{(}\theta^{CP})^2}{2} + \frac{\hat{(}\theta^*)^2}{2} \\ &= -\frac{(\mu_s + \mu_b)(\bar{\theta} + G)G}{2(2\mu_s\mu_b - \mu_s - \mu_b)} - \frac{(\bar{\theta} - G)^2}{8} + \frac{\left\{(\mu_s\mu_b - \mu_s - \mu_b)\bar{\theta} - \mu_s\mu_b G\right\}^2}{2(2\mu_s\mu_b - \mu_s - \mu_b)^2}, \end{aligned} \tag{18}$$

which is negative under Assumption 1 as long as $G > 0$ because the loss of firm 1 is greater than consumers' gain. In other words, the gross surplus generated by the consumption of a genuine product is greater than that generated from the consumption of a non-genuine product, and a purchase shift from genuine to non-genuine products decreases gross surplus. Fourth, an increase in the surplus of consumers who keep purchasing the

genuine product represents a redistribution from firm 1 to those consumers. Thus, in terms of welfare, an increase in the consumer surplus and a decrease in the profit of firm 1 cancel out. As a whole, the positive effects dominate the negative effect. Thus, complete prohibition necessarily improves welfare.[18]

Next, we consider a case in which only either one of two strategies, comparative advertising or technical barriers, is prohibited. In reality, the authority that regulates advertising is often different from the authority that regulates technical barriers.[19] Therefore, it is meaningful to examine partial prohibition, which is the prohibition of either advertising or technical barriers.

We let J denote the case of partial prohibition. The equilibrium price, consumption quantities, and the amount of advertising/technical barriers are as follows:

$$p_1^J = \frac{\mu_j(\bar{\theta}+G)}{2\mu_j - 1} + c_1, \quad x_1^J = \frac{\mu_j(\bar{\theta}+G)}{2\mu_j - 1},$$
$$x_2^J = \bar{\theta} - x_1^J, \quad j_1^J = \frac{\bar{\theta}+G}{2\mu_j - 1}, \qquad j = s, b.$$

Compared with the case in which only one strategy, advertising or technical barriers, is prohibited, the cost of running advertising or establishing technical barriers is saved in the case of complete prohibition:

$$\frac{\mu_j(\bar{\theta}+G)^2}{2(2\mu_j - 1)^2}. \tag{19}$$

On the other hand, the quantity of genuine products consumed under prohibition of only one strategy is greater than that under complete prohibition. Therefore, gross surplus in the latter case minus that in the former case may be negative:

$$-\frac{(\bar{\theta}+G)G}{2(2\mu_j - 1)} - \frac{(\bar{\theta}-G)^2}{8} + \frac{\left\{(\mu_j - 1)\bar{\theta} - \mu_j G\right\}^2}{2(2\mu_j - 1)^2}. \tag{20}$$

However, summing both effects, ((19) and (20)), reveals that the difference is necessarily positive: $3(\bar{\theta}+G)^2/\left\{8(2\mu_j - 1)\right\}^2 > 0$. Moreover, in the case of prohibition of advertising, there is an additional cost for non-genuine producers (b). This cost is swept out under complete prohibition.

Overall, we obtain the following result.

[18] See Appendix for the details.

[19] For example, in the case of Japan, the Consumer Affairs Agency regulates some types of advertising such as false advertising, whereas technical barriers are regulated by the Fair Trade Commission.

Proposition 2

(i) Welfare under complete prohibition of both comparative advertising and technical barriers is necessarily greater than that at market equilibrium.

(ii) Welfare under prohibition of either one of the two strategies is necessarily greater than that at market equilibrium.

(iii) Welfare under complete prohibition of both comparative advertising and technical barriers is necessarily greater than that under prohibition of either one of the two strategies.

(iv) Because both strategies complement each other, prohibition of either strategy suppresses the incentive of the genuine producer to increase the other strategy.

The third result of Proposition 2 reveals that even if only one strategy for firm 1 is allowed, the amount of advertising or the level of technical barriers is clearly excessive in terms of social welfare. This result also implies that even if advertising or the implementation of technical barriers gives rise to benefits from purchasing shifts, the loss incurred from paying the cost for running advertising or setting technical barriers dominates the benefits.

We should clarify who benefits from which type of prohibitive regulations. Proposition 2 suggests that, for society, complete prohibition is the most-preferred intervention, and the prohibition of either one strategy is better than no regulations.[20] The difference between prohibition of advertising and technical barriers is an increase in the marginal cost of good 2. Thus, prohibition of technical barriers is better than that of advertising. On the other hand, the more strategies the genuine producer has, the more profit it can gain. Thus, no regulation is the best situation, and prohibition of advertising and that of technical barriers are no different from the perspective of the genuine producer.[21]

5 Should Non-Genuine Producers Be Regulated?

5.1 Regulating Non-genuine Producers

Because the genuine producer has market power and sets the price of genuine products higher than the marginal cost, the supply of genuine products is insufficient in terms

[20] Recall that a small amount of advertising or technical barriers improves welfare. Thus, if it is possible for the government to fine-tune the level of advertising or technical barriers, complete prohibition is not the best choice.

[21] The present setting of the model assumes full coverage of the market. However, if partial coverage of the market is considered, welfare under complete prohibition of these strategies may be worse than that at market equilibrium. This situation occurs because these strategies may increase the total number of consumers who buy either genuine or non-genuine products.

of welfare. In this respect, the promotion of entry of non-genuine products seems to improve welfare. However, when non-genuine producers are allowed for entering into the market, the genuine producer may run advertising and establish technical barriers. If the costs for these strategies are large, the legal restriction of entry of non-genuine products may improve welfare by saving the costs. Although we have assumed that firm 1 cannot drive out non-genuine products from the market completely (see Assumption 1), the government may be able to shut out those non-genuine products completely by law, which restricts the rights of non-genuine producers. For example, supplying imitation products is usually strictly restricted to protect the benefit of genuine producers that have created new technologies and designs in many countries.

The strict restriction, such as complete prohibition of entry of non-genuine producers, is not necessarily the first-best choice. In fact, non-genuine/fake goods have been surviving such restrictive measures, which implies that there is enormous demand for cheaper non-genuine products.[22] However, it may sometimes be difficult for the government to fine-tune genuine and non-genuine producers' behavior. Thus, it is interesting to compare the case of prohibition of entry of non-genuine producers with the market equilibrium. Note that, under the prohibition, the genuine producer does not need to set technical barriers. Moreover, because we assume that advertising is comparative, the genuine producer does not run advertising either.

First, we examine whether the market is fully covered when entry of non-genuine producers is completely prohibited. In this case, firm 1 behaves as a monopolist. When it aims at full coverage, it has to set the price equal to v_1. If the price is higher than this value, consumers with low degree of love of genuineness purchase nothing. Total supply is $\bar{\theta}$ and the profit is $g_1\bar{\theta}$.

On the other hand, suppose that firm 1 chooses partial coverage. The surplus of consumer θ is $u = v_1 - p_1 + \theta$. Therefore, the demand for a genuine product is given by $x_1^M = \bar{\theta} + v_1 - p_1$, and the profit of firm 1 is represented as $\pi_1^M = (p_1 - c_1) \cdot (\bar{\theta} + v_1 - p_1)$, where superscript M denotes the case of no entry of non-genuine producers. Solving the profit maximization problem, we obtain the equilibrium price and output:

$$p_1^M = \frac{\bar{\theta} + g_1}{2} + c_1, \quad x_1^M = \frac{\bar{\theta} + g_1}{2}. \tag{21}$$

[22] In the case of fake designer goods, such as bags and wallets, see the following articles: O'connell and Hudson (2006); Anonymous, May 11, 2011, "South Korean capital's government clamps down on fake goods," *BBC Monitoring Asia Pacific*; Arceo-Dumlao (2011).

Therefore, the profit at equilibrium is

$$\pi_1^M = \frac{(\bar{\theta} + g_1)^2}{4}.$$

Comparison of the profit under full coverage and that under partial coverage reveals that the former is smaller than the latter:

$$g_1\bar{\theta} - \frac{(\bar{\theta} + g_1)^2}{4} = -\frac{(\bar{\theta} - g_1)^2}{4} < 0.$$

Thus, firm 1 necessarily chooses partial coverage.

From (7) through (9), we obtain the equilibrium profit with entry of non-genuine products:

$$\pi_1^* = \frac{\mu_s\mu_b(\bar{\theta} + G)^2}{2(2\mu_s\mu_b - \mu_s - \mu_b)}.$$

Note that $(\mu_s\mu_b)/(2\mu_s\mu_b - \mu_s - \mu_b)$ is greater than $1/2$. Thus, when μ_s, μ_b, and g_2 are relatively small, the profit with entry of non-genuine products is likely to be greater than that in the absence of non-genuine products. Interestingly, in such a case, the comparison between (8) and (21) reveals that the amount of genuine products consumed with entry of non-genuine products is likely to be greater than that in the absence of non-genuine products. Moreover, (7) and (21) reveals that the price of good 1 is also higher when non-genuine producers enter the market than when entry is prohibited. This fact implies that consumers who purchase genuine products lose from the entry of non-genuine producers, whereas consumers who purchase non-genuine products benefit from the entry of non-genuine producers. In this respect, it can be concluded that prohibition of non-genuine producers may have a type of redistribution effect from genuine producers and consumers who purchase non-genuine products to consumers who purchase genuine products.

On the other hand, if μ_s, μ_b, and g_2 are relatively large, firm 1 cannot drive out non-genuine products effectively, and accordingly, the profit of firm 1 with entry of non-genuine products is smaller than that in the absence of non-genuine products. Moreover, the consumption quantity of genuine products can be smaller with the entry of non-genuine producers than that under entry prohibition.

In terms of welfare, the costs of running advertising and setting technical barriers are saved by prohibition of entry of non-genuine producers, which is given by (17). The smaller the cost parameters and the larger the value of G, the larger the value of (17). Thus, in terms of cost saving of advertising and technical barriers, cost parameters and

the difference in the true-quality-cost gaps between genuine and non-genuine products play a key role in determining whether prohibition is welfare-improving.

The welfare effect of prohibition also depends on the degree of purchase shift from non-genuine to genuine products. Equation (21) reveals that the consumption quantity under prohibition of non-genuine products does not depend on the cost parameters of advertising and technical barriers: the larger the g_1, the larger the consumption quantity. On the other hand, the consumption quantity of non-genuine products under entry prohibition depends on the cost parameters and the true-quality-cost gaps of both products. In particular, the larger the cost parameters and the smaller the difference in the true-quality-cost gaps, the greater the consumption quantity of non-genuine products. It is obvious that when the consumption quantity of non-genuine products is large, and when the consumption quantity of genuine products under entry prohibition is large, the positive purchase-shift effect of entry prohibition is strong.

Table 1 highlights four typical cases. In Cases 1 and 2, the profit of firm 1 (consumer surplus) is smaller (greater) when non-genuine products are supplied than when they are prohibited to enter the market. However, welfare in the former situation is smaller (greater) than in the latter situation in Case 1 (Case 2). Case 3 is interesting: Both the amount of genuine products consumed and welfare are greater when genuine products are supplied than in the absence of those products. In Case 4, the profit of firm 1 is greater in the former situation than in the latter.

When non-genuine products are supplied, firm 1 has an incentive to increase the demand for genuine products by driving out non-genuine products from the market. When the cost parameters are small, the demand-expansion effect of genuine products is large. Thus, the amount of genuine products consumed can be greater when non-genuine products are supplied than when no non-genuine producers enter the market.[23]

[23]The importance of technical barriers should be noted. Even if there are no non-genuine products, firm 1 may be able to expand demand for genuine products by running persuasive advertising, although it is not comparative. Rather, firm 1 runs advertising that excessively emphasizes the positive features of its product. Even in such a case, firm 1 cannot expand its demand by setting a technical barrier, which implies that firm 1 has more means to increase demand for its product in the presence of entry of non-genuine products than in the absence of such entry. Consequently, it may hold that the amount of genuine products consumed is greater with the entry of non-genuine products than without such entry.

5.2 Which Producers Should Be Regulated?

Finally, we compare the case of regulating the genuine producer, i.e., complete prohibition of advertising and technical barriers, with the case of regulating non-genuine producers, i.e., entry prohibition. In other words, we investigate whose rights should be restricted.

As described in the previous subsection, we focus on the case in which the market is partially covered under prohibition of non-genuine producers. Equations (15) and (21) reveal that the consumption of genuine products is greater under prohibition of non-genuine products than under regulation of the genuine producer. However, at least, consumers with very low θ purchase nothing when no non-genuine product is supplied. Thus, which type of regulation is superior depends on the sizes of g_1 and g_2, which can be verified as follows.

Consider the shift from the case of regulation of the genuine producer to the case of entry prohibition of non-genuine products. From (15), the welfare loss caused by losing non-genuine products is given by

$$\lambda_1 = -\frac{g_2 \cdot (\bar{\theta} - g_1 + g_2)}{2}, \tag{22}$$

and the welfare gain by an increase in the purchase of genuine products is given by

$$\lambda_2 = \int_{\frac{\bar{\theta}-g_1}{2}}^{\frac{\bar{\theta}-g_1+g_2}{2}} (g_1 + \theta)\, d\theta. \tag{23}$$

Total effect is obtained by summing up (22) and (23):

$$\lambda_1 + \lambda_2 = -\frac{g_2 \cdot (2\bar{\theta} - 10g_1 + 3g_2)}{8}. \tag{24}$$

Thus, we obtain the following proposition.

Proposition 3

As compared with welfare in the case of regulating the genuine producer, welfare under entry prohibition of non-genuine products is likely to be greater (i) when the true-quality-cost gap of the genuine product is large, and/or (ii) the true-quality-cost gap of non-genuine products is small. Moreover, the magnitude of the welfare effect depends on the true-quality-cost gap of non-genuine products.

For example, if both of g_1 and g_2 are large, the consumption of genuine products under prohibition of non-genuine producers can be much greater than that under regulation of the genuine producer. Thus, the benefit gained from changes in purchasing products

from non-genuine to genuine products generated by entry prohibition, which represents an increase in gross surplus from the consumption of good 1, dominates the loss of consumers who buy nothing under prohibition of non-genuine producers. In addition, the magnitude of the welfare effect is large.

We have compared two extreme situations. However, even if the government is able to fine-tune the amount of advertising and/or the level of technical barriers, determining which type of producers should be regulated depends on the true-quality-cost gaps. We presented examples concerning the printer ink industry. There has been a growing demand for the protection of the rights of genuine producers, as indicated by the trend towards the stricter protection of intellectual property rights. In the printer and ink industry, giant genuine producers appear to have advantages over third-party ink-cartridge suppliers. However, if we focus only on the aspect of intellectual property rights, we may choose a situation in which there are too few non-genuine producers in the market.

6 Investment in Quality Improvement

Improvement in true quality is another strategy for differentiating a genuine product from non-genuine products. In this section, we focus on the quality improvement of a genuine product and clarify the effect of an increase in quality improvement on advertising, technical barriers, and welfare.

For clarity, we redefine the qualities of both types of products: $v_1 = v + V_1$ and $v_2 = v + V_2$. V_i $(i = 1, 2)$ denotes quality improvement. Firm 1 invests in quality improvement, i.e., the investment directly increases V_1. However, the spillover effect exists in the improvement of the quality of genuine products: $V_2 = \alpha V_1$. The variable α can be considered to represent the degree of patent protection: The stricter the protection of patents is, the smaller α becomes. The profit of firm 1 can be rewritten as follows:

$$\pi_1^V = (p_1 - c_1) \cdot x_1 - C_s(s) - C_b(b) - C_v(V_1), \quad C_j' > 0, \quad C_j'' > 0 \quad (j = s, b, v)$$

where the last term denotes the cost of quality investment. Superscript V denotes the case involving quality investment. We consider the following sequential choices of variables by firm 1.[24] In the first stage, firm 1 chooses the amount of quality improvement; in the second stage, it simultaneously chooses the level of advertising, technical barriers, and

[24]This sequential setting is a device for clarifying the results of this section. Because there is only one player in this game, firm 1, the setting of simultaneous determination leads to the same choices.

price of the genuine product. The equilibrium variables in the second stage can be written similarly to those in Section 3.1 (Eqs (7), (8), and (9)).

First, let us examine the effect of a change in quality on the price and consumption quantity of a genuine product, advertising, and technical barriers. From (8) and (9), we obtain

$$\frac{\partial p_1^V}{\partial V_1} = \frac{(1-\alpha)\mu_s\mu_b}{2\mu_s\mu_b - \mu_s - \mu_b}, \quad \frac{\partial x_1^V}{\partial V_1} = \frac{(1-\alpha)(\mu_s+\mu_b)}{2(2\mu_s\mu_b - \mu_s - \mu_b)},$$
$$\frac{\partial s^V}{\partial V_1} = \frac{(1-\alpha)\mu_b}{2\mu_s\mu_b - \mu_s - \mu_b}, \quad \frac{\partial b^V}{\partial V_1} = \frac{(1-\alpha)\mu_s}{2\mu_s\mu_b - \mu_s - \mu_b}. \tag{25}$$

From Assumption 1, it holds that $0 < \partial b^V/\partial V_1 < \partial p_1^V/\partial V_1 < 1$. Consequently, we obtain the following result: (i) Quality improvement of genuine products (an increase in V_1) necessarily increases advertising, technical barriers, and the consumption quantity of genuine products at market equilibrium; (ii) the price increase of genuine products is smaller than the quality increase of genuine products; (iii) the price increase of non-genuine products is smaller than the quality increase of non-genuine products; and (iv) (a) the stricter the protection of patents is and (b) the smaller the cost parameters are, the greater the price increase becomes. The results (ii) and (iii) reveal that a consumer who continues to purchase a genuine or a non-genuine product benefits from the quality improvement. On the other hand, the effect of quality improvement on the surplus of consumers who change their purchased products is ambiguous because of the existence of a distortion caused by comparative advertising.

Then, we ask whether the quality investment improve welfare. From (12), (14) and the envelope theorem, total differentiation of welfare with respect to quality improvement yields the following:

$$\left.\frac{dW}{dV_1}\right|_{\partial\pi_1/\partial j=0\ (j=s,b,V_1)} = -\left(\frac{s_1^{V*}}{2} + \frac{x_1^{V*}}{2}\right)\cdot\frac{ds_1^{V*}}{dV_1} - \left(\hat{\theta}^{V*} + \frac{s_1^{V*}}{2} + \frac{x_1^{V*}}{2}\right)\cdot\frac{db_2^{V*}}{dV_1}$$
$$+\alpha\hat{\theta}^{V*} - \frac{(1-\alpha)s_1^{V*}}{2} + \frac{(1+\alpha)x_1^{V*}}{2}. \tag{26}$$

From (8), (9), and (25), we obtain the following proposition.

Proposition 4

Suppose that there are no regulations on advertising and technical barriers. When the protection of patents is strict, an increase in quality investment at market equilibrium decreases welfare. On the other hand, when the protection of patents is lax, an increase in quality investment at market equilibrium improves welfare.

See Appendix for the details. The intuition is as follows. When the protection of patent is strict, the spillover effect is small and, accordingly, the price decrease of genuine products caused by this spillover is small. Moreover, in such a situation, the quality improvement of genuine products increases the market power of genuine producers, which leads to large increases in advertising and technical barriers. Thus, it is likely that the loss from increases in advertising and technical barriers dominates the gains obtained from quality improvement. On the other hand, when the protection of patents is lax, the gains dominate the loss.

Furthermore, (25) reveals that when the cost parameters are small, advertising and technical barriers increase greatly in response to an increase in the quality of genuine products. Thus, it is more likely that (26) is negative.

7 Conclusion

In this paper, we examined a genuine producer's behavior in driving out non-genuine products. In particular, we considered how the strategic behavior of a genuine producer, such as running comparative advertising, establishing technical barriers, and improving product quality, affects the market equilibrium; whether the government should regulate such behavior of the genuine producer or the entry of non-genuine producers.

We demonstrated that both advertising and technical barriers are excessive at market equilibrium in terms of social welfare, although a small amount/level of advertising/technical barriers improves welfare. The key factors are an insufficient supply of genuine products and the costs of running advertising and establishing technical barriers. Advertising and technical barriers mitigate the insufficiency by shifting consumption from non-genuine products to genuine products. However, advertising and technical barriers are costly, and the cost of non-genuine products also increases in the case of technical barriers. The latter negative effect dominates the former positive effect at market equilibrium, whereas the former effect dominates the latter effect when the amount of advertising or technical barriers is small.

Because the excess of advertising and technical barriers at market equilibrium is serious, welfare is greater under complete prohibition of both advertising and technical barriers than at market equilibrium. We also found that prohibition of entry of non-genuine producers may improve welfare because the consumption of genuine products increases and the costs of advertising and technical barriers are saved.

Moreover, we investigated the case in which a firm producing genuine products can invest in quality improvement. An improvement in the quality of genuine products leads to increases in advertising and technical barriers when there are no regulations. Therefore, an improvement in the quality of genuine products may decrease welfare. In such a case, the driving-out strategies of genuine producers should be regulated.

Our results reveal that in the presence of efforts by genuine producers to drive out non-genuine products, legal restriction of those efforts may be justified. The government should also consider the possibility that prohibition of entry of non-genuine producers is a better way to improve welfare compared with regulating genuine producers' driving-out strategies. Moreover, when considering the promotion of quality investment and/or stricter patent protection, the government should consider the responses of genuine producers to the driving-out strategies.

Appendix

The Details for Proposition 2

We examine the first result. Summing up (16) through (18), we obtain welfare under prohibition of both advertising and technical barriers less welfare under the market equilibrium:

$$\begin{aligned} W^{CP*} - W^* &= \frac{1}{8(2\mu_s\mu_b - \mu_s - \mu_b)^2} \cdot \left\{ (12\mu_s^2\mu_b + 4\mu_s\mu_b^2 - 5\mu_s^2 - 2\mu_s\mu_b + 3\mu_b^2)\bar{\theta}^2 \right. \\ &\quad \left. -(2\mu_s^2 - 4\mu_s\mu_b - 6\mu_b^2)\bar{\theta}G - (4\mu_s^2\mu_b - 3\mu_s^2 - 6\mu_s\mu_b - 3\mu_b^2)G^2 \right\}. \end{aligned}$$

From Assumption 1, the difference above is positive irrespective of the sigh of G.

The Details for Proposition 4

From (8), (9), and (25), we obtain that

$$\begin{aligned} &-\left(\frac{s_1^{V*}}{2} + \int_{\hat{\theta}^{V*}}^{\bar{\theta}} \frac{1}{2} d\theta \right) \cdot \frac{ds_1^{V*}}{dV_1} - \left(\hat{\theta}^{V*} + \frac{s_1^{V*}}{2} + \int_{\hat{\theta}^{V*}}^{\bar{\theta}} \frac{1}{2} d\theta \right) \cdot \frac{db_2^{V*}}{dV_1} \\ &= -\frac{(1-\alpha)\mu_s}{2\mu_s\mu_b - \mu_s - \mu_b} \cdot \hat{\theta}^{V*} \\ &\quad -\frac{(1-\alpha)\mu_b(\mu_s + \mu_b)(\mu_s + 1)}{2(2\mu_s\mu_b - \mu_s - \mu_b)^2} \cdot \left\{ \bar{\theta} + (v_1^{V*} - c_1) - (v_2^{V*} - c_2) \right\} \end{aligned}$$

On the other hand,

$$\begin{aligned} &\alpha\hat{\theta}^{V*} - \frac{(1-\alpha)s_1^{V*}}{2} + \int_{\hat{\theta}^{V*}}^{\bar{\theta}} \frac{1+\alpha}{2} d\theta \\ &= \alpha\hat{\theta}^{V*} + \frac{\mu_b((1+\alpha)\mu_s - (1-\alpha))}{2(2\mu_s\mu_b - \mu_s - \mu_b)} \cdot \left\{ \bar{\theta} + (v_1^{V*} - c_1) - (v_2^{V*} - c_2) \right\}. \end{aligned}$$

Thus, the smaller (larger) is α, the more likely it is that (26) is negative (positive).

References

[1] Arceo-Dumlao, T. (2011). Louis Vuitton sees more harm than flattery in cheap imitations, *Tribune Business News*, July 24, 2011.

[2] Bagwell, K. (2007). The economic analysis of advertising, in Armstrong, Mark and Robert Porter eds., *Handbook of Industrial Organization 3*, North Holland, 1701-1844.

[3] Bessen, J., and E. Maskin (2009). Sequential innovation, patents, and imitation, *RAND Journal of Economics* 40, 611-635.

[4] Ceccagnoli, M. (2005). Firm heterogeneity, imitation, and the incentives for cost reducing R&D effort, *Journal of Industrial Economics* 53, 83-100.

[5] Dixit, A., and V. Norman (1978). Advertising and welfare, *Bell Journal of Economics* 9, 1-17.

[6] Gallini, N. T. (1992). Patent policy and costly imitation, *RAND Journal of Economics* 23, 52-63.

[7] Glaeser, E. L., and G. Ujhelyi (2010). Regulating misinformation, *Journal of Public Economics* 94, 247-257.

[8] Hattori, K., and K. Higashida (2012). Misleading advertising in duopoly, *Canadian Journal of Economics* 45, 1154-1187.

[9] Hattori, K., and K. Higashida (2014). Misleading advertising and minimum quality standards, *Information Economics and Policy* 28, 1-14.

[10] Hattori, K., and K. Higashida (2015). Who benefits from misleading advertising?, *Economics*, forthcoming.

[11] Jeff, B. (2008). Cheap ink: will it cost you?, *PC World* 26.8, 93-98.

[12] Klempler, P. (1990). How broad should the scope of patent protection be?, *RAND Journal of Economics*, 21, 113-130.

[13] Lyon, T. P., and H. Huang (1996). Innovation and imitation in an asymmetrically-regulated industry, *International Journal of Industrial Organization* 15, 29-50.

[14] Mizuno, M., and H. Odagiri (1990). Does advertising mislead consumers to buy low-quality products?, *International Journal of Industrial Organization* 8, 545-558.

[15] O'connell, V., and K. Hudson (2006). Not our bag, Coach says in a lawsuit alleging target sold counterfeit purse, *Wall Street Journal*, October 3, 2006.

[16] Pepall, L. M., and D. J. Richards (1994). Innovation, imitation, and social welfare, *Southern Economic Journal* 60, 673-684.

[17] Rajagopal, P., and N. V. Montgomery (2011). I imagine, I experience, I like: the false experience effect, *Journal of Consumer Research* 38, 578-594.

[18] Rozhon, T., and R. Thorner (2005). On the Streets, Genuine Copies (And a Few Originals), *New York Times*, May 26, 2005.

[19] Wright, D. J. (1999). Optimal patent breadth and length with costly imitation, *International Journal of Industrial Organization* 17, 419-436.

Table 1. Comparison between Entry and No Entry of Non-genuine Products. ($c_1=c_2=0$)

	Parameters					With Non-Genuine (Market Equilibrium)				No Non-genuine			
	v1	v2	$\overline{\theta}$	μ s	μ b	x1	CS	π 1	Welfare	x1	CS	π 1	Welfare
Case 1	8	6	40	5	10	24.7	324.3	518.8	843.1	24	288	576	864
Case 2	8	6	40	8	20	23	392.6	483.3	875.9	24	288	576	864
Case 3	4.5	2.8	30	8	20	17.4	171.1	275.3	446.4	17.3	148.8	297.6	446.3
Case 4	8	4	40	4	10	26.7	231.1	586.7	817.8	24	288	576	864

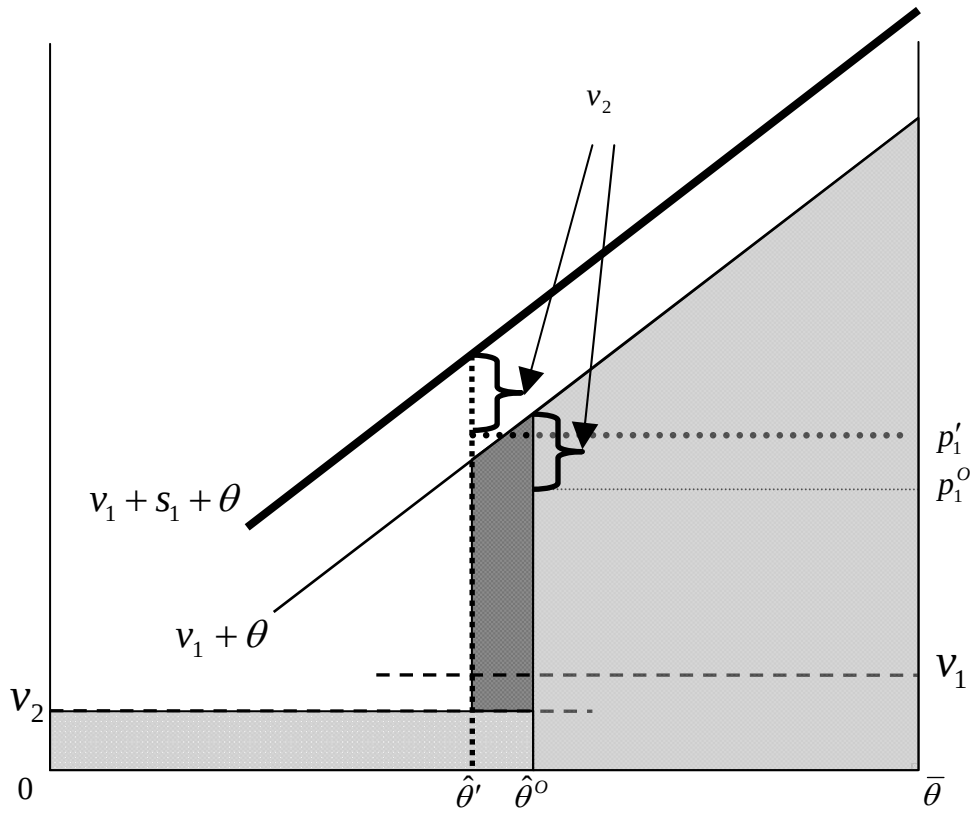

Figure 1. The case where an increase in misinformation increases gross surplus.

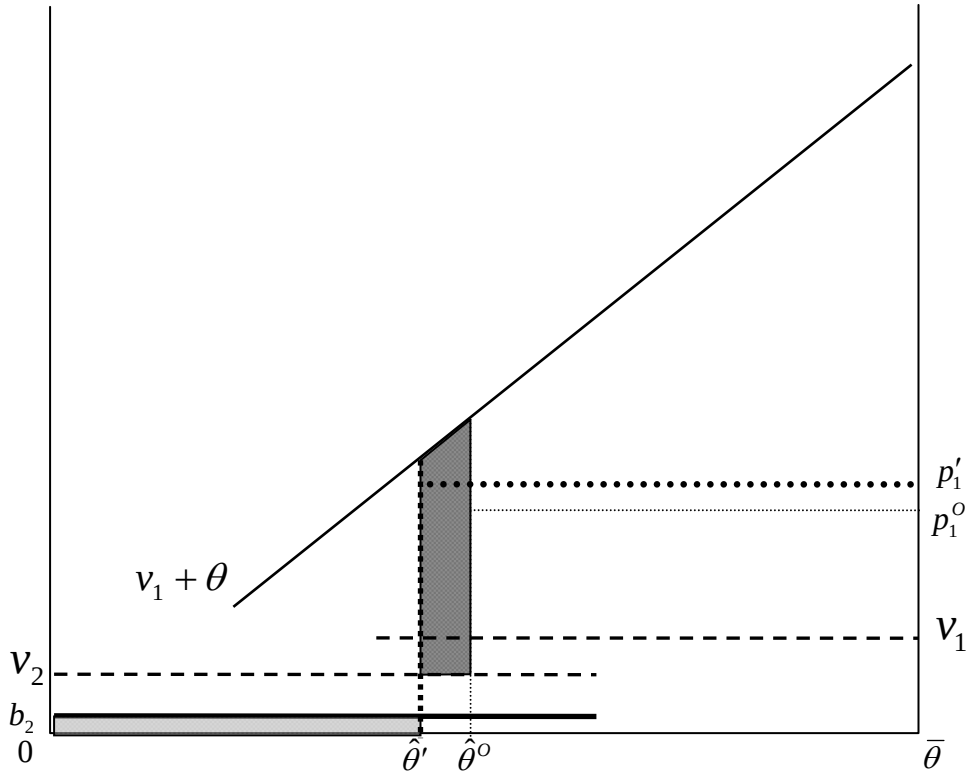

Figure 2. The case where an increase in technical barriers increases gross surplus.